JITTA

JOURNAL OF INFORMATION TECHNOLOGY THEORY AND APPLICATION

ISSN: 1532-3416

Enhancing Reflexivity in Software Development Teams: Should We Focus on Autonomy or Interdependence?

Adarsh Kumar Kakar
Computer Information Systems Department
Alabama State University
akakar@alasu.edu

Abstract:

Researchers widely recognize reflexivity, the extent to which teams reflect on and modify their functioning, as a key factor of work teams' effectiveness. Therefore, enhancing team reflexivity is critical, especially in an environment of uncertainty and change. In this study, I propose that work design can play an important role in promoting team reflexivity. I identify three salient characteristics of team work design (task interdependence, outcome (goal) interdependence, and autonomy of team members), and I also propose a model of their interrelationships. I conducted an empirical study with 167 team members from 34 software projects and found that, while the identified team characteristics significantly and positively impacted reflexivity, they also interacted with each other in complex ways. While, at low outcome interdependence, autonomy and task interdependence demonstrated an antagonistic impact on team reflexivity, at high outcome interdependence, autonomy and task interdependence demonstrated a synergistic impact on team reflexivity. I discuss the implications of these findings.

Keywords: Task Autonomy, Task Interdependence, Outcome Interdependence, Team Reflexivity.

Marcus A. Rothenberger was the Senior Editor for this paper.

1 Introduction

In the contemporary workplace, organizations face greater uncertainty and complexity than they ever have in the past (Parker, Wall, & Cordery, 2001). Many of these factors are external to the organization and, therefore difficult to control, such as uncertain customer demands, the growing rate at which technology changes, economic conditions, and competition. These uncertainties result in unpredictability in the inputs, processes, and/or outputs of work systems (Wall, Cordery, & Clegg, 2002; Wright & Cordery, 1999).

Further, most organizations deploy teams to accomplish work (Osterman, 2000), which includes developing software. Therefore, organizations need to design teams in a way that enables them to cope successfully in an environment of uncertainty and change, which is especially relevant for non-routine and complex jobs such as software development. In an environment of ever-changing customer requirements and technological changes, one needs to continuously reflect to decide on the best course of action.

A key mechanism that enables teams to monitor and react successfully to their environment is reflexivity (West, 2000). Team reflexivity refers to the "extent to which group members overtly reflect upon the group's objectives, strategies and processes, and adapt them to current or anticipated endogenous or environmental circumstances" (West, 1996, p. 559). It involves constantly questioning, exploring, and analyzing. Reflexivity is critical for recognizing changes in external and internal environments and for learning. As such, research has unsurprisingly positively linked reflexivity to team performance and creativity (De Dreu, 2002).

Additionally, not all teams facing such ambiguity and change may find it easy to define problems and prioritize their resolution. However, reflexive teams can better explore new ways of looking at situations and examining hidden patterns in an uncertain environment and, as a result, are more likely to find superior and timely solutions to their problems (Hirokawa, 1990; Schwenk, 1988). A reflexive team better recognizes the consequences of its actions and, thereby, its ability to adapt under rapidly evolving situations. Because one can only rarely manage uncertainty through control systems (e.g., Weick, Sutcliffe, & Obstfeld, 1999), organizations rely on employees and teams to take initiative to change how they execute work and on work designs that enable such behaviors (Frese & Fay, 2001; Staw & Boettger, 1990).

Self-reflection enables teams to constantly scan and assess dynamic situations and come to a clear and accurate understanding of complex environmental and technological changes. Further, it encourages team members to communicate better and exchange ideas and enhances their ability to handle challenging tasks. Constant reflection is also likely to boost the role-breadth self-efficacy of individual team members (i.e., confidence in their capabilities to carry out a wider range of tasks and responsibilities effectively) (Parker, 1998). Reflexive teams, through their constant interactions, better recognize their members' expertise and can, thereby, identify the right person/s to effectively address emerging problems.

Two salient factors of work design are interdependence and autonomy (Guzzo & Dickson, 1996). Interdependence characterizes teams and represents a significant reason for why teams form. No individual team member possesses all the skills required to develop the software product except arguably in the simplest of cases. Therefore, interdependence among team members is unavoidable. On the other hand, autonomy in teams provides an effective way of accomplishing individual tasks as the best people in the team who know how a task should be completed are those who implement them (Emery, 1993). Therefore, teams should allow as much freedom in terms of work pace and work methods as possible (Hackman & Oldham 1976) and encourage self-management practices (Herbst, 1974; Morgan, 1986).

Contribution:

This study contributes to our understanding of how critical team design parameters such as interdependence and autonomy can positively and negatively impact team reflexivity. Team reflexivity is widely acknowledged in literature as salient for accomplishing salutatory project outcomes. Therefore, the insights from the study are useful for project managers to effectively managing software development projects. Further, the study adds to our understanding of what distinguishes agile methods from plan-driven methods of software development. Thus, by adding to our existing body of knowledge in the area, the findings are also relevant for researchers interested in investigating the theory, methods and practices of software development.

However, balancing interdependence and autonomy can be tricky. It may lead to a catch-22 situation as team interdependence constricts autonomy and autonomy undermines interdependence (Janz, Collquitt, & Noe, 1997). Autonomy under conditions of high interdependence can lead to a team's frequently adjusting tasks, compromises, and conflicts (Niepce & Molleman, 1988). As a result, instead of valuing their autonomy, team members may dislike the time and effort spent in reflective and decision making processes that they could have used in completing their own tasks (Janz et al., 1997).

Keeping this context in view, I investigate how one can simultaneously leverage both task interdependence and autonomy to engender reflexivity in software development teams. What is the trade-off in deciding between task interdependence and autonomy? When should one focus on autonomy versus interdependence? Further, how do these factors affect reflexivity in the context of plan-driven versus agile team designs? Gleaning concepts from a multi-disciplinary review of the literature, I first identify and then develop a theoretical model of the relationship between the relevant factors of team design and reflexivity. I tested the model with team members of actual software development projects and found it valid. I discuss the implications of the findings for software development and avenues for future research.

2 Literature Review

Since the industrial revolution, work design theories have been useful in describing and explaining the behaviors of employees (Hackman & Oldham, 1974). Specifically, "Work design describes how jobs, tasks, and roles are structured, enacted, and modified, as well as the impact of these structures, enactments, and modifications on individual, group, and organizational outcomes" (Grant & Parker, 2009, p. 319). Work design affects employees' tasks and their psychological and health outcomes such as performance, turnover and absenteeism, job satisfaction, internal work motivation, stress, and burnout (e.g., Parker & Wall, 1998).

Work design research began with introducing the concepts of division of labor and task specialization for improve economic efficiencies at work (Babbage, 1835; Smith, 1776). Adam Smith (1776) suggested that organizations divide labor by breaking down complex jobs into simpler jobs as a way of enhancing performance. Expanding on these ideas, Charles Babbage (1835) pointed out the added advantages of simplifying jobs, such as their requiring less-skilled and, thus, cheaper labor. Task interdependence arises due to this division of labor in groups or departments (Saavedra, Earley, & Van Dyne, 1993; Thompson, 1967; van de Ven, Delbecq, & Koenig, 1976).

Charles Babbage's (1835) and Adam Smith's (1776) concepts influenced the methods of software development during the early stages of its evolution. Methods such as the waterfall method (Royce, 1970) and its variants encouraged organizations to divide labor, which led to specialized roles of business analysts, system architects, programmers, and testers (Melnik & Maurer, 2006). F. W. Taylor's (1911) concepts also influenced these plan-driven methods: he introduced scientific management to control every work activity. He applied to workers the ideas Eli Whitney (see Mirsky & Nevins, 1952) earlier used for making interchangeable parts.

Taylor analyzed tasks into their minutest details and arrived at a standardized process; the one best way to do the job (Kanigel, 1997), just as Eli Whitney analyzed a musket into its smallest parts and made a machine to manufacture each part (Mirsky & Nevins, 1952). Together, the ideas of Whitney, Taylor, and Ford (of moving assembly line) ushered in the era of mass production (Mirsky & Nevins, 1952). Software development teams implemented these concepts to develop software in the form of upfront planning, defined processes, sequential development phases, coding standards, inspections and reviews, productivity metrics, and statistical quality control (Royce, 1970). As a result, team members of plan-driven methods have limited autonomy. Managers not only assigned tasks to the team members but also specified how they should be performed and by when they should be completed (Grant & Parker, 2009).

In the manufacturing domain, while mass production improved individuals' standard of living, it had deleterious psychological consequences for workers. Workers found repetitive jobs boring, tiring, and dissatisfying, and they potentially damaged the workers' mental health (Fraser, 1947; Walker & Guest, 1952). As such, dividing labor and specializing tasks diverted researchers' attention to human issues at work. They conducted studies to investigate whether one could enhance employee satisfaction and motivation by improving working conditions (Mayo, 1933, 1945; Roethlisberger & Dickson, 1939). Some researchers proposed that enriched job characteristics such as enlarged rather than narrow tasks improve employee satisfaction (Turner & Lawrence, 1965; Herzberg, 1966; Herzberg, Mausner, & Snyderman,

1967). Hackman and Oldham (1976) suggested that, when employees have the freedom to schedule their work and decide on procedures, it increases the motivating potential of work.

Further, increasing uncertainty at the workplace implies that defining and assigning jobs to employees may not work. When uncertainty is low, one can predict events and know how to deal with them. As such, one can determine and enforce the "one best way" of doing the job. In contrast, when uncertainty is high, one cannot as easily predict events and one does not readily know how to deal with them, which means one should provide employees with greater autonomy so they can structure their work to deal with the changing environment.

Indeed, general organizational theory proposes that "mechanistic" structures with routinized tasks and centralized decision making suit stable conditions and that "organic" structures with decentralized decision making suit more uncertain environments (e.g., Burns & Stalker, 1961). The importance of uncertainty and related variables in determining the degree of autonomy in work design is especially relevant in service and knowledge-work settings (Bowen & Lawler, 1992).

The aforementioned shift in concepts from process to people and from division of labor and rigid task interdependencies to task autonomy and integration were also reflected in the Agile manifesto in 2001 and led to the evolution of software development methods. Agile development proponents questioned the assumption that one can control change and uncertainty through a high degree of advanced planning and rigid processes (Nerur, Mahapatra, & Mangalraj, 2005). Software developers realized that, while Tayloristic plan-driven methods do work well in stable conditions, under uncertain conditions, managers may not be able to plan, assign, and control software developers' tasks. Therefore, agile methods emphasize team and employee autonomy in organizing and performing work.

However, even though employee autonomy and the integration of tasks into meaningful work increased, interdependence's importance did not decline. With tasks becoming more socially embedded than at any other time in the past, work design researchers recognized that work is inextricably intertwined with interactions among team members and interpersonal relationships (Grant & Parker, 2009). Complex jobs such as software development require multiple skills, task interdependencies, and intense coordination among team members. Therefore, autonomous self-organizing teams who adjust themselves to the work define agile work. Hence, in today's uncertain business environment that features rapidly evolving customer requirements, one can reasonably assume that both employee autonomy and interdependence are important considerations in the design of effective teams.

However, to my knowledge, no study investigated the interplay between task interdependence and autonomy in designing work to engender team reflexivity. Increasing task interdependence may constrain autonomy, and increasing autonomy may reduce task interdependence. So where does the balance lie? How does one decide what levels of autonomy and interdependence will produce the best results in enhancing team reflexivity and, thereby, team effectiveness?

3 Theory Development

Studies have shown that knowledge workers rate autonomy higher than any other job characteristic (Cheney, 1984; Goldstein & Rockart, 1984; Janz et al., 1997). Autonomy is the degree to which a job provides an employee with freedom, independence, and the discretion to schedule work and determine the procedures to perform it (Hackman & Oldham, 1976). Increased autonomy has many benefits, including cognitive development (Kohn & Schooler, 1978), increased self-efficacy (Burr & Cordery, 2001; Parker, 1998; Speier & Frese, 1997), more responsibility for external coordination with those in other departments (Batt, 1999), creativity and innovation, and greater use of personal initiative and engagement in accomplishing tasks (Frese, Kring, Soose, & Zempel, 1996).

High levels of uncertainty require knowledge about the product and the process as a whole, and larger analytical and problem-solving capacities (Niepce & Molleman, 1988). Parker (1998) found that autonomy not only provides employees an opportunity to master new responsibilities and acquire new skills but also boosts their self-efficacy by increasing how much they can control a task (Gist & Mitchell, 1992). Further, with increased autonomy, employees develop confidence and the capability to carry out a wider range of responsibilities and tasks (Parker, 1998). Armed with this higher role-breadth self-efficacy, employees proactively seek and strive to achieve more challenging goals (Parker, Wall, & Jackson, 1997), which results in their developing more proactive role orientations (Parker et al., 1997) and, thus, employees'

becoming more aware of the consequences of their own their colleagues' actions on team goals. As such, I hypothesize that:

Hypothesis 1: Autonomy increases team reflexivity.

Interdependence characterizes groups and largely constitutes why they form (Campion, Medsker, & Higgs, 1993; Cartwright & Zander, 1968; Shea & Guzzo, 1987). Interdependence in work teams exists because they contain interrelated tasks for converting inputs into outputs. Kiggundu (1981, 1983) found that task interdependence in teams has a significant motivating potential. Further, he classified task interdependency into two types by differentiating between initiated and received task interdependence. Received task interdependence refers to the extent to which the work flow from one or more other jobs affects a person in a particular job (van der Vegt, Emans, & van de Vliert, 1998). Initiated task interdependence refers to the extent to which work flows from one particular job to one or more other jobs so that the performance of the latter depends on the initiating job (van der Vegt et al., 1998). Pearce and Gregersen (1991) argue that reciprocal interdependence, a characteristic of most jobs, which occurs when employees initiate and receive interdependence, would cultivate the highest levels of felt responsibility, motivate extra-role helping and citizenship behaviors, and lead team members to reflect on (team) issues beyond performance of their own tasks. As such, I hypothesize that:

Hypothesis 2: Task Interdependence increases team reflexivity.

To examine the interactions between task interdependence and autonomy, I also examined goal interdependence's moderating and direct effects on reflexivity. Outcome interdependence refers to the extent to which team members believe that their personal benefits and costs depend on other team members' successfully attaining their goals (van der Vegt et al., 1998). If the team members feel that their fellow team members' achieving their goals do not relate to their own goals or do not share a similar purpose (low outcome interdependence), they are likely to consider time spent in reflection with other team members a waste of time or even detrimental to their self-interest. They will be interested in focusing on accomplishing their own task for personal rewards and may withhold information that they perceive might benefit the group at their expense. By contrast, common goals and rewards (high outcome interdependence) help pull team members together and encourage team members to pursue their own tasks and cooperate with other team members in addressing challenges facing the group as a whole. Employees will be more likely to share information and will look forward to collaborating with other team members in participative reflection and problem solving to achieve group goals in light of the changing environment. Team members who work under conditions of high outcome interdependence are more open-minded regarding others' arguments and desires, more concerned about others' outcomes, and more inclined to search for solutions and compromises (Campbell & Pritchard, 1976; Deutsch, 1949, 1973, 1980; Guzzo, 1986; Johnson & Johnson, 1989; Johnson, Maruyama, Nelson, & Skon, 1981; Tjosvold, Andrews, & Sruthers, 1991; Tjosvold & Deemer, 1980), which enhances team reflexivity. As such, I hypothesize that:

Hypothesis 3: Outcome interdependency increases team reflexivity.

Theoretically, high and low degrees of outcome interdependence may exist independently of the degree of task interdependence and autonomy. One achieves outcome interdependence by defining and achieving goals and rewarding performance in a certain way (Wageman, 1995; Johnson & Johnson, 1989). For example, one may set superordinate or group goals at different levels of task interdependencies and autonomy, such as for programmers working independently and those engaged in paired programming. When outcome interdependence is high, team members believe that other team members' goal attainment facilitates movement toward their own goals (Deutsch, 1949, 1973, 1980; Kelley & Thibaut, 1978). However, when outcome interdependence is low, the individual goals of team members become salient. Therefore, they will focus on accomplishing their own task for personal reward. Team members may believe that working reflexively with other team members to successfully achieve group goals may compromise them from accomplishing their own goals (Deutsch, 1949, 1973, 1980; Kelley & Thibaut, 1978). This heightened tension between interdependence and autonomy will have a deleterious impact on team reflexivity.

By contrast, high outcome interdependence can act as the social glue in the group regardless of task interdependence and autonomy levels. Common goals and rewards mitigate the deleterious impacts of simultaneously having high task interdependence and autonomy by increasing cooperation. With common goals and rewards comes the realization that, unless all team members perform adequately, the group will not meet its goals. As such, common goals and rewards are likely to increase cooperation, cohesion, and

trust among team members and, thus, result in a synergistic impact of high task interdependence and autonomy on team reflexivity. Employees will view fellow employees' superior performance as enablers and not as a threat and look forward to collaborating with them in participative reflection and problem solving to achieve the group's goal in light of changing environment. As such, I hypothesize that:

Hypothesis 4: Outcome interdependence moderates the combined impacts of task interdependence and autonomy on reflexivity such that, when the outcome interdependence is high, the effects will be synergistic and, when the outcome interdependence is low, the effects will be antagonistic.

Plan-driven methods for developing software such as the waterfall method and its variants promote conforming to plans and encourage dividing labor, which leads to the specialized roles of business analysts, system architects, programmers, and testers (Melnik & Maurer, 2006). In plan-driven methods, tasks are process driven, team members have little autonomy, and points of employee interfaces are few. Typically, testers interact with coders but not with designers, and designers interact with requirement gatherers but not with system implementers. In an uncertain environment, this approach will not likely facilitate reflexivity among team members. By contrast, agile methods deploy self-managing teams compared to a hierarchical one with the command and control structures of plan-driven methods. Agile teams and its members have more autonomy (Highsmith, 2004; Nerur & Balijepally, 2007; Sharp & Robinson, 2004). Outcome interdependence is high. Group goals are the norm, and points of employee interface are many. Practices such as pair programming, planning games, and daily stand-up meetings continually highlight interdependence between tasks (Beck, 1999; Scrum Alliance, 2008). As such, I hypothesize that:

Hypothesis 5: Plan-driven methods are lower in autonomy, task interdependence, and outcome interdependence than agile methods, and its team members, therefore, demonstrate lower reflexivity.

4 Method

4.1 Study Setting and Design

To test the proposed hypotheses, I conducted a multi-year survey with development team members from 34 software projects. The developers included graduate students of a large public university who, as part of their degree requirements, had to complete a real-life software project with industry partners (which included 18 companies, three of which were in the Fortune 500 list). The type of projects, which the industry partners characterized, included 14 that used the waterfall method, four that used the V-method, nine that used extreme programming, three that used scrum, one that used crystal methodologies, one that used the dynamic software development method (DSDM), one that used feature-driven development (FDD), and one that used the lean software development method (LSDM). Due to the university's policies, I randomly assigned the students to alphabetically listed projects in the ascending order of their last names.

The capstone projects enable students to work on a real-life project and provide them with job opportunities. The university has a high placement rate, and the industry partners employ many of the students who work on the capstone projects. I completed the study over a four-year period that involved167 developers who answered a pen-and-pencil questionnaire based survey after they completed the projects. In all, 84% of the developers who participated in the 34 development projects responded. I used a multi-organizational approach because one can consider findings from multiple projects in a single organizational approach as idiosyncratic. The students worked on the project along with the development team of the industry partners in their premises and at the university. The projects lasted for between four to six months and had team sizes from four to 14 team members. The average time size was 6.3 members.

4.2 Variables Used in the Study

The independent variables were task interdependence, outcome interdependence, and software-development projects' team members' autonomy. The dependent variable was team reflexivity. I adapted tested measures from prior literature to capture data pertaining to these variables. I controlled for team size and team members' age and gender because they were not the variables of interest in the study.

Large team sizes make it more difficult for team members to interact with all other team members given the dramatic increase of possible individual links between team members as team size grows (Steiner, 1966). Thus, a large team size can affect collaborative team processes (Hackman, 1987; Campion et al., 1993) such as reflexivity among team members.

4.2.1 Task Interdependence

I used previously tested sub-scales (Kiggundu, 1983; Pearce & Gregersen, 1991) for initiated and received interdependence that comprised eight items. A sample item of initiated interdependence from this scale is "To what extent do your colleagues depend on you for information and advice?". A sample item of received interdependence is "To what extent do you depend on your colleagues for doing your work well?".

4.2.2 Outcome Interdependence

I used a bipolar scale of six items (van der Vegt, Emans,l & van de Vliert, 1998) to measure outcome interdependence. A sample item from this scale is: "When my colleagues succeed in their jobs, it works out negatively/ positively for me.".

4.2.3 Autonomy

I used the job diagnostic survey's (JDS) (Hackman & Oldham, 1974) list of three items to measure autonomy. A sample item from this scale is: "The job gives me considerable opportunity for independence and freedom in how I do the work.".

4.2.4 Reflexivity

I used a five-item scale developed by Hoegl and Parbooteah (2006) to measure reflexivity. A sample item from this scale is: "My team adjusted its task performance strategies in response to changes in the context and progress of the project.".

For a complete list of items used in the measures, see Appendix B. These measures used a nine-point Likert scale anchored from 1 (strongly disagree) to 9 (strongly agree) or 1 (very little) to 9 (very much). From reviewing the literature, I noted that expanding the number of choice-points beyond five or seven points does not systematically damage scale reliability, yet such an increase does increase scale sensitivity (Cummins & Gullone, 2000). As such, I averaged scale items to create an overall value for each construct. I coded responses such that high values represent high levels of the constructs. I reverse coded some items.

4.3 Subjects

The subjects were 19-28 year olds (94 males and 73 females) who were all enrolled in a graduate degree in management information systems. Their average age was 22.4 years. The graduate students provided a homogenous sample of subjects. Further, using graduate students as subjects helps mitigate biases due to prior work experience such as having to make adjustments to new methods (such as agile to plan-driven or vice versa) or comfort with using the same method. I did not administer the survey to 26 graduate students who had prior work experience with real-life software-development projects.

4.4 Procedure

Subjects answered a pen-and-paper survey that captured data on the independent variables (task interdependence, outcome interdependence, and autonomy) and the dependent variable (the software-development project team's reflexivity). I scrambled the items that the questionnaire listed. I collected data on the independent variables from the subjects in the first round of the study. I collected data on the dependent variables in the second round a week later. Previous research demonstrates that the temporal separation between measures reduces potential effects due to common method variance (Sharma, Yetton, & Crawford, 2009).

4.5 Variables Used in the Study

To establish reliability and validity of the measures used in the study, I performed factor analysis and examined the measures' internal reliabilities and correlation matrix. I used moderated hierarchical multiple

regression (MHMR), a widely recommended method for testing moderating relationships or interactions between independent variables (Cohen, 1978; Dunlap & Kemery, 1987; Stone & Hollenbeck, 1989; Cortina, 1993), to analyze the data. MHMR analysis revealed how well each independent variable predicted the dependent variable after extracting variance due to other independent variables in the regression equation and interaction effects after extracting variance due to independent variables.

MHMR first tests for the significance of the increment in criterion variance explained by the main effects after controlling for variance due to extraneous variables and then tests for the increment in criterion variance explained by interaction terms beyond those attributed to the main effects. As such, I conducted MHMR first to test for the main effects of the independent variables on reflexivity after controlling for team size and team members' gender and age, second to test for the two-way interaction effects among task interdependence, autonomy, and reflexivity, and third to test for the moderating effect of outcome interdependence on the effects of task interdependence and autonomy on reflexivity.

5 Results and Analyses

I performed the factor analysis procedure using IBM© SPSS© Statistics (ver. 19). I performed dimension reduction on the data pertaining to the four measurement scales. The results of Varimax rotation showed that the four factors extracted represented each of the four scales. All items of a scale (task interdependence: T1 to T8, outcome interdependence: O1 to O6, autonomy: A1 to A3 and reflexivity: R1 to R5) loaded on the respective factors (highlighted in bold in Appendix A). Convergent and discriminant validity between scales were evident (see Appendix A) by the high loadings in factors (> .50) and no cross loadings (> .40) between factors. I then examined the internal reliabilities of the scales used in the study (i.e., task interdependence, outcome interdependence, autonomy, and reflexivity). As Table 1 shows, the alpha reliabilities were all greater than .70.

Table 1. Internal Reliability of Scales

Name of the scale	Cronbach's alpha	N of items
Task interdependence (TI)	0.894	8
Outcome interdependence (OI)	0.818	6
Autonomy (A)	0.912	3
Reflexivity (R)	0.866	5

Table 2 provides the means and standard deviations of the data collected in this survey. From the correlation between variables in Table 4, one can see that none of the correlations were too high (> 0.65), which demonstrates that each scale added something new.

Table 2. Means, Standard Deviations, and Correlations

Variable	Mean	Std. dev	1	2	3	4
TI	5.280	1.118	1			
OI	5.234	0.905	0.285*	1		
A	5.679	0.949	0.157	0.114	1	
R	5.625	0.922	0.111	0.207*	0.103	1
* p < .05 ** p < .01 *** p < .001						

Before analyzing the results of MHMR in Table 3, I examined the normal probability plot to ascertain normal distribution of residuals. I included the variance inflation factor (VIF) option in the analyses to explore the extent of multicollinearity in the results. All the VIF values were less than 1.5, which indicates a lack of multicollinearity in results (Hair, Black, Babin, Anderson, & Tatham, 2006).

Results from MHMR analysis in Table 3 support Hypotheses 1, 2 and 3, which concern autonomy's, task interdependence's, and outcome interdependence's direct impacts on team reflexivity. Further, the results show a significant ($p < .01$) three-way interaction among task interdependence, outcome interdependence, and autonomy in predicting reflexivity. Analyzing the three way interaction using the slope test (Aiken & West, 1991) revealed that, at low outcome interdependence (1 standard deviation below mean) and low task interdependence (1 standard deviation below mean), autonomy had a

significantly ($p < .01$) positive impact ($B = 0.324$) on reflexivity, while, at low outcome interdependence (1 standard deviation below mean) and high task interdependence (1 standard deviation above mean), autonomy had a significantly ($p < .01$) negative impact ($B = 0.219$) on reflexivity.

Further, at high outcome interdependence (1 standard deviation above mean) and low task interdependence (1 standard deviation below mean), autonomy had a non-significant ($p < .01$) impact on reflexivity, while, at high outcome interdependence (1 standard deviation below mean) and high task interdependence (1 standard deviation above mean), autonomy had a significantly ($p < .01$ positive impact ($B = 0.425$) on reflexivity.

As Table 3 shows, the two-way interactions between autonomy, task interdependence, and outcome interdependence were also significant ($p < .05$). Although I report them for sake of completeness, I did not analyze them independently. Interpreting the two-way interactions is constrained by the presence of the significant three-way interactions. The presence of significant ($p < .01$) three-way interactions supports Hypothesis 4; that is, that task interdependence and autonomy have a positive effect on reflexivity at high outcome interdependence and a negative effect on reflexivity at low outcome interdependence.

Table 3. Moderated Hierarchical Multiple Regression Analysis results for Reflexivity

Step	Variables added in each step	Change in R-square	Regression coefficients
1	**Control variables**		
	Age, gender, and team size	0.083**	0.034, 0.127, -1.951**
2	**Main effect**		
	Task interdependence (TI)	0.188***	3.258***
	Outcome interdependence (OI)	0.092***	5.269***
	Autonomy (A)	0.079**	2.642**
3	**Two-way interactions**		
	A * TI, A*OI, OI*TI	0.021	-2.275*, 0.291, 0.132
4	**Three-way interactions**		
	A * TI * OI	0.091***	4.427**
* p < .05 ** p < .01 ***p<.001			

6 Discussion

This study's results show that autonomy has a significant positive impact on reflexivity only when both task and outcome interdependence are low or when both task and outcome interdependence are high. Therefore, practitioners have two options. When team members' perception of outcome dependence is low, one should design software-development teams for low interdependence and high autonomy. Alternatively, when team members' perception of outcome interdependence is high, one should design software-development teams for high interdependence and high autonomy.

However, software development is a complex endeavor that requires diverse skills and competencies. The first option of low task interdependence may, therefore, not be viable. Hence, software projects that wish to enhance team reflexivity should focus on enhancing autonomy and task and outcome interdependence. Table 4 evidences the validity of focusing on all three. Software development projects that used agile methods that are significantly higher than plan-driven methods in all the three criteria (i.e., task interdependence, outcome interdependence, and autonomy) were also significantly higher in reflexivity. As such, the results support Hypothesis 5.

In reviewing software development practices, I found how agile methods simultaneously increase all the three aspects of team design. Practices such as collective ownership of code (which means that everyone owns the code and that anyone can change it to improve the system) promote positive outcome interdependence (Beck, 1999). Autonomous, self-organizing teams use planning game or sprint planning meetings to plan for the next development iteration (or sprint). All team members participate in these meetings that highlight interdependence among team members in achieving the goals of the upcoming iteration (Beck, 1999; Scrum Alliance, 2008). After completing an iteration retrospectives occur in which team members collaboratively discuss their performance in the previous iteration and identify strategies

for improvement (Scrum Alliance, 2008). Agile processes are typically light weight (unlike plan-driven methods), and team members are trusted to decide for themselves the best way to perform a task.

Table 4. Comparison of Agile and Plan-driven Methods

	Agile methods			Plan-driven methods			
Variables	**Mean**	**Standard deviation**	**N**	**Mean**	**Standard deviation**	**N**	**Difference in means**
Task interdependence (TI)	5.544	1.123	81	5.031	0.987	86	0.513*
Outcome interdependence (OI)	5.602	0.851	81	4.887	1.065	86	0.715**
Autonomy (A)	6.669	0.983	81	4.747	0.931	86	1.022**
Reflexivity (R)	6.105	0.942	81	5.172	1.124	86	0.903***
* p < .05 ** P < .01 ***p<.001							

7 Contribution

Team reflexivity positively impacts team effectiveness and efficiency (Hoegl & Parbooteah, 2006) because reflexivity involves each team member's presenting their accounts of the situation. As such, they are less likely to be judgmental about ideas and more likely to find the best solution to problems (Rogelberg, Barnes-Farrell, & Lowe, 1992). Keeping this context in view, I model and test the relationship between autonomy, task interdependence, outcome interdependence, and reflexivity. My results validate the model. By expounding the complex relationships between these constructs, this study provides a systematic way of designing teams for engendering reflexivity.

Additionally, the results show that the team members of agile projects demonstrate higher reflexivity compared to the team members of plan-driven methods. Keeping in view reflexivity's salutary impacts on team effectiveness, the model I propose provides a rationale for the effectiveness and increasing popularity of agile methods compared to plan-driven methods of software development (Dyba & Dingsøyr, 2008; Abrahamsson, Conboy, & Wang, 2009). The findings suggest that the key may lie in agile methods' enabling positive outcome interdependence among team members. By establishing collective responsibility and ownership, agile methods can simultaneously leverage the salutary effects of higher autonomy and task interdependence in enhancing reflexivity.

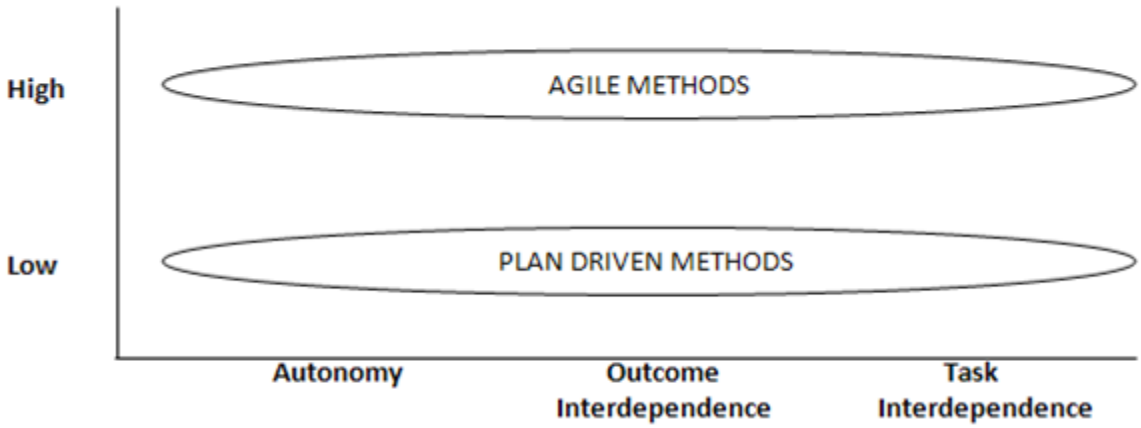

Figure 1. Differences in Team Design Characteristics between Agile and Plan-driven Methods

Dingsøyr, Nerur, Balijepally, and Moe (2012, p. 1217) state that "theoretically comprehending the distinction between agile methods and plan-driven methods is a concern begging for research attention". This study suggests that the distinction may lie in the two teams' design (Figure 1). Agile methods appeared as a reaction to the process-dominated approach of plan-driven methods. When processes become too heavy and one enforces compliance, creativity and flexibility suffer. Additionally, they inhibit agility in responding to uncertainty and change. Further, processes that specify how one should perform work inhibit employee autonomy, which is a key factor in reflexivity. By setting collective goals and

highlighting task interdependence (through frequent face-to-face interactions in the form of daily stand-up meetings and team-planning exercises) but leaving the choice on how to perform the individual tasks to the team members, agile methods enhance reflexivity and project outcomes.

However, one should view these contributions in light of the following limitations. Although the literature broadly classify software-development methods into two categories—agile methods and plan-driven or Taylorist methods—each category has many different methods that each have their own principles and practices, which makes comparing them confusing. For example, organizations use many agile methods, such as extreme programming, scrum, crystal methodologies, the dynamic software development method (DSDM), feature-driven development (FDD), and the lean software development method (LSDM). Each focuses heavily on some of the principles of the agile manifesto and completely ignores others, which makes it impossible to reach any conclusions on specific agile methods and their use (Conboy & Fitzgerald, 2004).

Hence, my results only broadly reflect the distinction between agile methods and plan-driven methods. The sample size did not permit further statistical analyses of differences in these two major paradigms. Future studies could test the validity model I propose for specific methods of software development in these two broad categories. Also, one should examine the generalizability of the findings with other types of software-development team members such as the more experienced or those with specific roles such as programming, testing, or deigning software systems. Further, because I used self-reports for this study, common method bias could have possibly inflated the effect size. However, methods bias is unlikely to produce such inflation for moderation effects (Schmitt, 1994); the interaction effects are more likely to be attenuated rather than inflated (Evans, 1985).

References

Abrahamsson, P., Conboy, K., & Wang, X. (2009). "Lots done, more to do": The current state of agile systems development research. *European Journal of Information Systems, 18*(4), 281-284.

Aiken, L., & West, S. (1991). *Multiple regression: Testing and interpreting interactions*. Thousand Oaks, CA: Sage.

Babbage, C. (1835). *On the economy of machinery and manufacturing*. London: Knight.

Batt, R. (1999). Work organization, technology, and performance in customer service sales. *Industrial and Labor Relations Review, 52*, 539-564.

Beck, K. (1999). *Extreme programming explained: Embrace change* (1st ed.). Boston: Addison-Wesley.

Bowen, D. E., & Lawler, E. E. (1992). The empowerment of service workers: What, why, how, and when. *Sloan Management Review*, 33(3), 31-39.

Burns, T., & Stalker, G. M. (1961). *The management of innovation*. London: Tavistock.

Burr, R., & Cordery, J. L. (2001). Self-management efficacy as a mediator of the relation between job design and employee motivation. *Human Performance, 14*, 27-44.

Campbell, J. P., & Pritchard, R. D. (1976). Motivation theory in industrial and organizational psychology. In M. D. Dunnette (Ed.), *Handbook of industrial and organizational psychology*. Chicago: Rand McNally.

Campion, M. A., Medsker G. J., & Higgs A. C. (1993). Relations between work group characteristics and effectiveness: Implications for designing effective work groups. *Personnel Psychology, 46*, 823-850.

Cartwright, C., & Zander, A. (1968). *Group dynamics: Research and theory*. New York: Harper & Row.

Cheney, P. H. (1984). Effects of individual characteristics, organizational factors, and task characteristics on computer programmer productivity and job satisfaction. *Information and Management, 7*, 209-214.

Conboy, K., & Fitzgerald, B. (2004). Toward a conceptual framework of agile methods: A study of agility in different disciplines. In *Proceedings of XP/Agile Universe*.

Cohen, J. (1978). Partialled products are interactions: Partialled powers are curve components. *Psychological Bulletin, 85*, 858-866.

Cortina, J. M. (1993). Interaction, nonlinearity, and multicollinearity: Implications for multiple regression. *Journal of Management*, *19*(4), 915-922.

Cummins, R. A., & Gullone, E. (2000). The case for subjective quality of life measurement. In *Proceedings of the 2nd International Conference on Quality of Life in Cities* (pp. 74-93).

De Dreu, C. (2002). Team innovation and team effectiveness: The importance of minority dissent and reflexivity. *European Journal of Work and Organizational Psychology, 3*, 285-298.

Deutsch, M. (1949). An experimental study of the effects of cooperation and competition upon group process. *Human Relations, 2*, 199-231.

Deutsch, M. (1973). *The resolution of conflict: Constructive and destructive processes.* New Haven, CT: Yale University Press.

Deutsch, M. (1980). Fifty years of conflict. In L. Festinger (Ed.), *Retrospections on social psychology* (pp. 46-77). New York: Oxford University Press.

Dingsøyr, T., Nerur, S., Balijepally, V., & Moe, N. B. (2012). A decade of agile methodologies: Towards explaining agile software development. *Journal of Systems and Software, 85*(6), 1213-1221.

Dunlap, W. P., & Kemery, E. R. (1987). Failure to detect moderating effects: Is multicollinearity the problem? *Psychological Bulletin, 102,* 418-420.

Dyba, T., & Dinsoyr, T. (2008). Empirical studies of agile software development: A systematic review. *Information and Software Technology, 50*(9-10), 833-859.

Emery, F. (1993). Epilogue. In F. M. van Eijnatten (Ed.), *The paradigm that changed the work place*. Assen: Van Gorcum.

Evans, M. G. (1985). The Monte Carlo study of the effects of correlated method variance in moderated multiple regression analysis. *Organizational Behavior and Human Decision Processes, 36*, 305-323.

Fraser, R. (1947). *The incidence of neurosis among factory* workers (Report No. 90). London: HMSO.

Frese, M., & Fay, D. (2001). Personal initiative: An active performance concept for work in the 21st century. In B. M. Staw & R. I. Sutton (Eds.), *Research in organizational behavior* (vol. 23 pp. 133-187). Amsterdam: Elesevier.

Frese, M., Kring, W., Soose, A., & Zempel, J. (1996). Personal initiative at work: Differences between East and West Germany. *Academy of Management Journal, 39*, 37-63.

Gist, M. E., & Mitchell, T. R. (1992). Self-efficacy: A theoretical analysis of its determinants and malleability. *Academy of Management Review*, *17*(2), 183-211.

Goldstein, D. K., & Rockart, J. F. (1984). *An* examination of work-related correlates of job satisfaction in programmer/analysts. *MIS Quarterly, 8*(2), 103-115.

Grant, A. M., & Parker, S. K. (2009). Redesigning work design theories: The rise of relational and proactive perspectives. *The Academy of Management Annals*, *3*(1), 317-375.

Guzzo, R. A. (1986). Group decision making and group effectiveness in organizations. In P. Goodman (Ed.), *Designing effective work groups*. San Francisco: Jossey-Bass.

Guzzo, R. A, & Dickson, M. U. (1996). Teams in organizations: Recent research on performance and effectiveness. *Annual Review of Psychology, 47*, 307-338.

Hackman, J. R., & Oldham, G. R. (1974). *The job diagnostic survey: An instrument for the diagnosis of jobs and the evaluation of job redesign projects* (Technical report no. 4). Department of Administrative Sciences, Yale University

Hackman, J. R., & Oldham, G. R. (1976). Motivation through the design of work: Test of a theory. *Organizational Behavior and Human Performance, 16*, 250-279.

Hackman, J. R. (1987). The design of work teams. In J. W. Lorsch (Ed.), *Handbook of organizational behavior* (pp. 67-102). Englewood Cliffs, NJ: Prentice-Hall.

Hair, J. F., Jr., Black, W. C., Babin, B. J., Anderson, R. E., & Tatham, R. L. (2006). *Multivariate data analysis* (6th ed.). New Jersey: Prentice Hall.

Herbst, P. G. (1974). *Socio-technical design: Strategies in multidisciplinary research*. London: Tavistock Publications.

Herzberg, F. (1966). *Work and the nature of man.* Oxford: World Publishing.

Herzberg, F., Mausner, B., & Snyderman, B. B. (1967). *The motivation to work* (2nd ed.). NewYork: Wiley.

Highsmith, J. (2004). *Agile project management: Creating innovative products.* Boston: Addison-Weasley.

Hirokawa, R. Y. (1990). The role of communication in group decision-making efficacy: A task-contigency perspective. *Small Group Research*, *21*, 190-204.

Hoegl, M., & Parboteeah, K. P. (2006). Team reflexivity in innovative projects. *R&D Management, 36*(2), 113-125.

Jackson, S. (1989). Does Job Control Control Job Stress? In S. L. Sauter, J. Hurrell, Jr., & C. L. Cooper (Eds.). *Job control and worker health* (pp. 25-53). New York: John Wiley & Sons.

Janz, B. D., Colquitt, J. A., & Noe, R. A. (1997). Knowledge worker team eVectiveness: The role of autonomy, interdependence, team development, and contextual support variables. *Personnel Psychology, 50*, 877-904.

Johnson, D. W., & Johnson, R. T. (1989). *Cooperation and competition: Theory and research.* Edina, MN: Interaction Book Company.

Johnson, D. W., Maruyama, G., Nelson, D., & Skon, S. (1981). Effects of cooperative, competitive, and individualistic goal structures on achievement: A meta-analysis. *Psychological Bulletin, 89*, 47-62.

Kanigel, R. (1997). *The one best way: Frederick Winslow Taylor and the enigma of efficiency*. New York: Viking.

Kelley, H. H., & Thibaut, A. (1978). *Interpersonal relations*. New York: John Wiley.

Kiggundu, M. N. (1981). Task interdependence and the theory of job design. *Academy of Management Review, 6*, 499-508.

Kiggundu, M. N. (1983). Task interdependence and job design: Test of a theory. *Organizational Behavior and Human Performance, 31*(2), 145-172.

Kohn, M. L., & Schooler, C. (1978). The reciprocal effects of the substantive complexity of work on intellectual complexity: A longitudinal assessment. *American Journal of Sociology, 84*, 24-52.

Mayo, E. (1933). *The human problems of an industrial civilization*. New York: MacMillan.

Mayo, E. (1945). *The social problems of an industrial civilization.* Cambridge, MA: Harvard University Press.

Melnik, G., & Maurer, F. (2006). Comparative analysis of job satisfaction in agile and non-agile software development teams. In P. Abrahamsson, M. Marchesi, & G. Succi (Eds.), *XP 2006* (LNCS 4044, pp. 32-42). Berlin: Springer.

Mirsky, J., & Nevins, A. (1952). *The world of Eli Whitney*. New York: The Macmillan Company.

Morgan, G. (1986). *Images of organizations*. Beverly Hills, CA: Sage.

Nerur, S., Mahapatra, R., & Mangalaraj, G. (2005). Challenges of migrating to agile methodologies. *Communications of the ACM*, *48*(5), 72-78.

Nerur, S., & Balijepally, V. (2007). Theoretical reflections on agile development methodologies. *Communications of the ACM, 50*(3), 79-83.

Niepce, W., & Molleman, E. (1998). Work design issues in lean production from a socio-technical systems perspective: NeoTaylorism or the next step in socio-technical design? *Human Relations, 51*, 259-287.

Osterman, P. (2000). Work reorganization in an era of restructuring: Trends in diffusion and effects on employee welfare. *Industrial and Labor Relations Review, 53*, 179-196.

Parker, S. K., Wall, T. D., & Jackson, P. R. (1997). "That's not my job": Developing flexible employee work orientations. *Academy of Management Journal, 40*(4), 899-929.

Parker, S. K. (1998). Role breadth self-efficacy: Relationship with work enrichment and other organizational practices. *Journal of Applied Psychology, 83*, 835-852.

Parker, S. K., & Wall, T. (1998). *Job and work design: Organizing work to promote well-being and effectiveness.* London: Sage.

Parker, S. K., Wall, T. D., & Cordery, J. (2001). Future work design research and practice: Towards an elaborated model of work design. *Journal of Occupational and Organizational Psychology, 74*(4), 413-440.

Pearce, J. L., & Gregersen, H. B. (1991). Task interdependence and extra role behavior: A test of the mediating effects of felt responsibility. *Journal of Applied Psychology, 76*, 838-844.

Roethlisberger, F. J., & Dickson, W. J. (1939). *Management and the worker.* Boston: Harvard University Press.

Rogelberg, S. G., Barnes-Farrell, J. L., & Lowe, C. A. (1992). The stepladder technique: An alternative group structure facilitating effective group decision making. *Journal of Applied Psychology, 77*(5), 730-737.

Royce, W. W. (1970). Managing the development of large software systems. In *Proceedings of IEEE WESCON* (pp. 328-338).

Saavedra, R., Earley, P. C., & Van Dyne L (1993). Complex interdependence in task-performing groups. *Journal of Applied Psychology, 78*(1), 61-72.

Schmitt, N. (1994). Method bias: The importance of theory and measurement. *Journal of Organizational Behavior, 15*(5), 393-398.

Schwenk, C. R. (1988). *The essence of strategic decision making*. Massachusetts: DC Heath.

Scrum Alliance. (2008). Scrum values. Retrieved from http: //www.scrumalliance.org/view/scrum_framework

Sharma, R., Yetton, P., & Crawford, J. (2009). Estimating the effect of common method variance: The method–method pair technique with an Illustration from TAM research. *MIS Quarterly, 33*(3), 473-490.

Sharp, H., & Robinson, H. (2004). An ethnographic study of XP practice. Empirical *Software Engineering*, *9*(4), 353-375.

Shea, G. P., & Guzzo, R. A. (1987). Groups as human resources. In K. M. Rowland & G. R. Ferris (Eds.), *Research in personnel and human resources management* (vol. 5, pp. 323-356). Greenwich, CT: JAI Press.

Smith, A. (1776). *An inquiry into the nature and causes of the wealth of nations.* London: W. Strahan and T. Cadell.

Speier, C., & Frese, M. (1997). Generalized self-efficacy as a mediator and moderator between control and complexity at work and personal initiative: A longitudinal field study in East Germany. *Human Performance, 10*(2), 171-192.

Staw, B. M., & Boettger, R. D. (1990). Task revision: A neglected form of work performance. *Academy of Management Journal, 33*(3), 534-559.

Steiner, I. D. (1966). Models for inferring relationships between group size and potential group productivity. *Behavioral Science*, *11*, 273-283.

Stone, E. F., & Holfenbeck, J. R. (1989). CIarifying some controversial issues surrounding statistical procedures for detecting moderator variables: Empirical evidence and related matters. *Journal of Applied Psychology, 74*(1), 3-10.

Taylor, F. W. (1911). *The principles of scientific management*. New York: W. W. Norton.

Thompson, J. D. (1967). *Organizations in action.* New York: McGraw-Hill,

Tjosvold, D., Andrews, I. R., & Struthers, J. T. (1991). Power and interdependence in work groups. *Group and Organization Studies, 16*, 285-299.

Tjosvold, D., & Deemer, D. K. (1980). Effects of controversy within a cooperative or competitive context on organizational decision making. *Journal of Applied Psychology, 65*, 590-595.

Turner, A. N., & Lawrence, P. R. (1965). *Industrial jobs and the worker.* Boston: Harvard University Press.

Van der Vegt, G. S., Emans, B. J. M., & Van de Vliert, E. (1998). Motivating effects of task and outcome interdependence in work teams. *Group and Organization Management, 23*, 12-144.

Van de Ven, A. H., Delbecq, A. L., & Koenig Jr, R. (1976). Determinants of coordination modes within organizations. *American Sociological Review*, *41*(2), 322-338.

Wageman R. (1995). Interdependence and group effectiveness. *Administrative Science Quarterly, 40*, 145-180.

Walker, C. R., & Guest, R. H. (1952). *The man on the assembly line.* Cambridge: Harvard University Press.

Wall, T. D., Cordery, J. L., & Clegg, C. W. (2002). Empowerment, performance, and operational uncertainty: A theoretical integration. *Applied Psychology: An International Review, 51*, 146-169.

Weick, K. E., Sutcliffe, K. M., & Obstfeld, D. (1999). Organizing for high reliability: Processes of collective mindfulness. In R. I. Sutton & B. M. Staw (Eds.), *Research in organizational behavior* (vol. 21, pp. 81-123). New York: Elsevier Science/JAI Press.

Wright, B. M., & Cordery, J. L. (1999). Production uncertainty as a contextual moderator of employee reactions to job design. *Journal of Applied Psychology, 84*(3), 456-463.

West, M. A. (1996). Reflexivity and work group effectiveness: a conceptual integration. In M. A. West (Ed.), *Handbook of work group psychology* (pp. 555–579). New York: John Wiley & Sons,

West, M. A. (2000). *Reflexivity, revolution and innovation in work teams*. In M. M. Beyerlein, D. A. Johnson, & S. T. Beyerlein (Eds.), *Product development teams* (vol. 5, pp. 1-29). Stamford CT: JAI Press.

Appendix A

Table A1. Measures Used in the Study

Measures and items
Reflexivity
My team investigated and observed the context and the progress of our project (e.g. task performance strategies, goals, project requirements, the organizational context).
My team adjusted its task performance strategies in response to changes in the context and progress of the project.
My team spent an adequate amount of time considering the likely consequences of its task activities (e.g. considerations regarding usability of the product, compatibility with other products, cost).
My team checks the strategies and work approaches for their appropriateness.
My team learned from its experiences.
Received task interdependence
To what extent do you depend on your colleagues for information and advice?
To what extent do you depend on your colleagues for materials, means, and other things you need?
To what extent do you depend on the presence, help, and support of your colleagues?
To what extent do you depend on your colleagues for doing your work well?
Initiated task interdependence
To what extent do your colleagues depend on you for information and advice?
To what extent do your colleagues depend on you for materials, means, and other things they need?
To what extent do your colleagues depend on your presence, help, and support?
To what extent do your colleagues depend on you for doing their work well?
Outcome interdependence
It (benefits/hinders) me when my colleagues attain their goals.
The things my colleagues want to accomplish and the things I want to accomplish are (compatible/ incompatible).
It is (advantageous/ disadvantageous) for me when my colleagues succeed in their jobs.
When my colleagues succeed in their jobs, it is at my (expense/benefit).
My concerns and those of my colleagues are (harmonious/ clashing).
When my colleagues succeed in their jobs, it works out (positively/ negatively) for me.
Autonomy
The job gives me considerable opportunity for independence and freedom in how I do the work
The job denies me any chance to use my personal initiative or judgment in carrying out the work. (Reverse coded)
The job provides substantial freedom, independence, and discretion to the employee in scheduling his work and in determining the procedures to be used in crying it out.

Appendix B

Table B2. Results of Factor Analysis

Items	Factor			
	1	**2**	**3**	**4**
T1	**0.943**	0.022	-0.043	-0.050
T2	**0.900**	0.021	0.018	0.038
T3	**0.905**	0.008	-0.053	-0.023
T4	**0.794**	-0.028	0.049	0.101
T5	**0.855**	-0.007	0.011	-0.141
T6	**0.839**	-0.032	0.075	-0.045
T7	**0.873**	0.018	0.027	0.060
T8	**0.881**	0.103	0.002	0.041
A1	0.042	**0.892**	0.125	0.133
A2	0.063	**0.839**	0.132	0.016
A3	0.015	**0.867**	0.125	0.093
O1	-0.082	-0.006	**0.634**	0.265
O2	0.070	0.085	**0.891**	0.004
O3	0.016	0.126	**0.856**	0.090
O4	0.032	0.193	**0.836**	0.107
O5	0.038	0.210	**0.858**	0.014
O6	-0.082	0.045	**0.766**	0.128
R1	-0.020	0.110	0.381	**0.726**
R2	0.029	0.146	0.106	**0.873**
R3	-0.004	0.072	0.134	**0.856**
R4	-0.013	0.021	-0.038	**0.831**
R5	0.006	0.068	0.135	**0.859**

About the Author

Adarsh Kumar Kakar is a PhD in Management Science with a research interest in theory, methods, and practices of software development. He has over three decades of experience in the software industry and has worked as consultant for many Fortune 500 companies. He is currently working as an Assistant Professor in the Department of Computer Information Systems at Alabama State University. He has papers in journals such as *Information and Software Technology, Computers in Human Behavior, Journal of Computer Information Systems,* and *Journal of Decision Systems*.

JITTA

JOURNAL OF INFORMATION TECHNOLOGY THEORY AND APPLICATION

JITTA is a Publication of the Association for Information Systems
ISSN: 1532-3416